# WELLS'S NEW FOUR-PLACE LOGARITHMIC TABLES

# FOUR PLACE

# LOGARITHMIC TABLES

TOGETHER WITH A

## TABLE OF NATURAL SINES, COSINES, TANGENTS, AND COTANGENTS

PREPARED BY

WEBSTER WELLS, S.B.

PROFESSOR OF MATHEMATICS IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

D. C. HEATH & CO., PUBLISHERS

BOSTON NEW YORK CHICAGO

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# USE OF THE TABLES.

## I. USE OF THE TABLE OF LOGARITHMS OF NUMBERS.

This table (pages 12 and 13) gives the mantissæ of the logarithms of all integers from 100 to 1000, calculated to four places of decimals.

### To find the Logarithm of a Number of Three Figures.

Look in the column headed "No." for the first two significant figures of the given number.

Then the required mantissa will be found in the corresponding horizontal line, in the vertical column headed by the third figure of the number.

Finally, prefix the characteristic in accordance with the rules of §§ 66 or 67.

For example, $\log 168 = 2.2253$;

$\log .0344 = 8.5366 - 10$; etc.

For a number consisting of one or two significant figures, the column headed 0 may be used.

Thus, let it be required to find log 83 and log 9.

By § 80, log 83 has the same mantissa as log 830, and log 9 the same mantissa as log 900.

Hence, $\log 83 = 1.9191$, and $\log 9 = 0.9542$.

### To find the Logarithm of a Number of more than Three Figures.

**Ex. 1.** Required the logarithm of 327.6.

From the table, $\log 327 = 2.5145$,

and $\log 328 = 2.5159$.

That is, an increase of one unit in the number produces an increase of .0014 in the logarithm.

Therefore, an increase of .6 of a unit in the number will produce an increase of .6 × .0014 in the logarithm, or .0008 to the nearest fourth decimal place.

Hence, $\log 327.6 = 2.5145 + .0008 = 2.5153$.

**Note I.** The above method is based on the assumption that the differences of logarithms are proportional to the differences of their corresponding numbers; which, though not strictly accurate, is sufficiently exact for practical purposes.

**Note II.** The difference between any mantissa in the table and the mantissa of the next higher number of three figures, is called the *tabular difference*. The subtraction may be performed mentally.

The following rule is derived from the above:

*Find from the table the mantissa of the first three significant figures, and the tabular difference.*

*Multiply the latter by the remaining figures of the number with a decimal point before them.* (See Note III.)

*Add the result to the mantissa of the first three significant figures, and prefix the proper characteristic.*

**Note III.** In finding the correction to the nearest unit's figure, the decimal portion should be omitted provided that, if it is .5 or more than .5, the unit's figure is increased by 1. Thus, 13.26 would be taken as 13; 30.5 as 31; 22.803 as 23.

Ex. 2. Find the logarithm of .021508.

| | |
|---|---|
| Mantissa 215 = 3324 | Tabular difference = 21 |
| 2 | .08 |
| 3326 | Correction = 1.68 = 2, nearly. |
| | Result, 8.3326 − 10. |

## To find the Number corresponding to a Logarithm.

Ex. 1. Required the number whose logarithm is 1.6571.

Find in the table the mantissa 6571.

In the corresponding line, in the column headed "No.," we find 45, the first two figures of the required number, and at the head of the column we find 4, the third figure.

Since the characteristic is 1, there must be two places to the left of the decimal point (§ 66).

Hence, the number corresponding to 1.6571 is 45.4.

Ex. 2. Required the number whose logarithm is 2.3934.

We find in the table the mantissæ 3927 and 3945, whose corresponding numbers are 247 and 248, respectively.

That is, an increase of 18 in the mantissa produces an increase of one unit in the number corresponding.

Therefore, an increase of 7 in the mantissa will produce an increase of $\frac{7}{18}$ of a unit in the number, or .4, nearly.

Hence, the number corresponding is 247 + .4, or 247.4.

The following rule is derived from the above:

*Find from the table the next less mantissa, the three figures corresponding, and the tabular difference.*

*Subtract the next less from the given mantissa, and divide the remainder by the tabular difference.* (See Note V.)

*Annex the quotient to the first three figures of the number, and point off the result.* (See Note IV.)

**Note IV.** The rules for pointing off are the reverse of the rules for characteristic given in §§ 66 and 67.

1. *If* −10 *is not written after the mantissa, add* 1 *to the characteristic, giving the number of places to the left of the decimal point.*

2. *If* −10 *is written after the mantissa, subtract the positive part of the characteristic from* 9, *giving the number of ciphers to be placed between the decimal point and first significant figure.*

Ex. 3. Find the number whose logarithm is 8.5265 − 10

5265

Next less mantissa = 5263; three figures corresponding, 336.

Tabular difference = 13)2.00(.15 = .2, nearly.

13

70

By the rule of Note IV., there will be one cipher between the decimal point and first significant figure.

Hence, the number corresponding = .03362.

**Note V.** The correction can usually be depended upon to one decimal place; the division should be carried out to two decimal places in order to determine the last figure accurately. (See Note III.)

## II. USE OF THE TABLE OF LOGARITHMIC SINE COSINES, ETC.

This table (pages 14 to 19) gives the logarithms of the sines, cosines, tangents, and cotangents of all angles at intervals of 10 minutes from 0° to 90°.

For angles between 0° and 45°, the degrees and minutes will be found in the *left-hand* column, and the functions in the columns designated by the names at the *top;* that is, sines in the first column, cosines in the second, tangents in the third, and cotangents in the fourth.

For angles between 45° and 90°, the degrees and minutes will be found in the *right-hand* column, and the functions in the columns designated by the names at the *foot;* that is, cosines in the first column, sines in the second, cotangents in the third, and tangents in the fourth.

If only the *mantissa* of the logarithm is found, the characteristic may be determined from the nearest logarithm in the same column in which the characteristic is given.

Since the sines and cosines of all acute angles, the tangents of angles between 0° and 45°, and the cotangents of angles between 45° and 90°, are less than unity, the characteristics of their logarithms have been increased by 10, and $-10$ must be written after the mantissa; in all other cases, the true value of the characteristic is given in the table.

Thus, $\log \sin 38° 30' = 9.7941 - 10$;

$\log \tan 65° 20' = 0.3380$;

$\log \cot 79° 10' = 9.2819 - 10$;

$\log \cos 89° 40' = 7.7648 - 10$; etc.

## To find the Logarithmic Sine, Cosine, Tangent, or Cotangent, of any Acute Angle expressed in Degrees and Minutes.

*Find from the table the logarithmic sine, cosine, tangent, or cotangent of the next less multiple of ten minutes, and the difference for* 1′ *corresponding.* (See Note VI.)

*Multiply this difference by the number of minutes remaining.*

*If sine or tangent, add*
*If cosine or cotangent, subtract* } *this correction.*

**Note VI.** The columns immediately to the right of those headed "Sin.," "Cos.," and "Tan.," contain the respective differences for 1′; the right-hand column of differences is also to be used with the column headed "Cot."

It will be observed that the differences do not stand in the same horizontal line with the logarithms, but opposite the intervals between consecutive logarithms. For angles *below* 45°, the difference next *below* should be taken; for angles *above* 45°, the difference next *above*.

**Note VII.** The rule assumes that the differences of the logarithmic functions are proportional to the differences of their corresponding angles, which, unless the angle is near to 0° or 90°, is in general sufficiently exact for practical purposes. (See page 9.)

**Note VIII.** If the angle is expressed in degrees, minutes, and seconds, the seconds should be reduced to the decimal part of a minute before applying the rule.

**Ex. 1.** Find log tan 17° 14′.

| | |
|---|---|
| log tan 17° 10′ = 9.4898 − 10 | D. 1′ = 4.5 |
| 18 | 4 |
| Result, 9.4916 − 10 | Corr. = 18.0 |

**Ex. 2.** Find log cos 58° 33.5′.

| | |
|---|---|
| log cos 58° 30′ = 9.7181 − 10 | D. 1′ = 2.1 |
| 7 | 3.5 |
| Result, 9.7174 − 10 | 1 05 |
| | 6 3 |
| | 7.35 = 7, nearly. |

## To find the Acute Angle corresponding to a given Logarithmic Sine, Cosine, Tangent, or Cotangent.

*Take from the table, if sine or tangent the next less, if cosine or cotangent the next greater, logarithmic function, the angle corresponding, and the difference for* 1′. (See Note IX.)

*Find the difference between the given logarithm and that taken from the table, and divide it by the difference for* 1′, *giving the correction in minutes.*

*Add the result to the angle corresponding to the next less, or next greater, function.*

**Note IX.** In searching for the next less (or greater) logarithm, attention must be paid to the fact that the functions are found in different columns according as the angle is below or above 45°.

If, for example, the next less logarithmic sine is found in the column with "Sin." at the *top*, the angle corresponding must be taken from the *left-hand* column; but if it is found in the column with "Sin." at the *foot*, the angle corresponding must be taken from the *right-hand* column. Similar considerations hold with respect to the other three functions.

**Ex. 1.** Find the angle whose log sin = 9.9594 − 10.

9.9594 − 10

Next less log sin = 9.9590 − 10; angle corresponding = 65° 30′

D. 1′ = .6)4.0(6.66 = 6.7, nearly.

Adding the correction, the result is 65° 36.7′.

**Ex. 2.** Find the angle whose log cot = 0.1696.

Next greater log cot = 0.1710; angle corresponding = 34° 0′

0.1696

D. 1′ = 2.7)14.0(5.18 = 5.2, nearly.

13 5

50

27

230 Result, 34° 5.2′.

### To find the Logarithmic Secant or Cosecant of any Acute Angle.

Since $\sec x = \frac{1}{\cos x}$ and $\csc x = \frac{1}{\sin x}$, we have by § 85,

$$\log \sec x = \operatorname{colog} \cos x, \text{ and } \log \csc x = \operatorname{colog} \sin x.$$

Hence, *to find the logarithmic secant, subtract the logarithmic cosine from* $10 - 10$; *and to find the logarithmic cosecant, subtract the logarithmic sine from* $10 - 10$.

Ex. Find $\log \sec 22° 38'$.

From the table, $\log \cos 22° 38' = 9.9652 - 10$

Subtracting from $10 - 10$, we have

$$\log \sec 22° 38' = 0.0348.$$

**Note X.** The logarithmic cotangent of an angle may be obtained by subtracting the logarithmic tangent from $10 - 10$.

### To find the Logarithmic Functions of an Angle not lying between the Limits 0° and 90°.

By § 34, any function of any angle may be expressed as a function of a certain acute angle; and hence the table of the functions of acute angles serves to determine the functions of angles of any magnitude whatever, positive or negative.

Ex. Find $\log \sin 152° 16'$.

By § 84, $\sin 152° 16' = \cos 62° 16'$.

Then, $\log \sin 152° 16' = \log \cos 62° 16' = 9.6678 - 10$.

Another method would be to find the logarithmic sine of $27° 44'$, the supplement of $152° 16'$ (§ 32).

**Note XI.** If the natural function is *negative*, as for example in the case of the cosine of an angle between 90° and 180°, there is no logarithmic function, strictly speaking. (See Note before § 87.)

In solving examples involving such functions, we proceed as if the functions were positive, and determine the algebraic sign of the result irrespective of the logarithmic work. Illustrations of this will be found Chapters X. and XI.

### III. USE OF THE TABLE OF NATURAL SINES AND COSINES.

This table (pages 20 and 21) gives the natural values of the sines and cosines of all angles at intervals of 10 minutes from 0° to 90°, calculated to four places of decimals.

Its use is similar to that of the table of logarithmic functions, except that the tabular differences for 1′ are not given, but are to be calculated from the table when required.

Ex. 1. Find sin 48° 52′.

The difference between sin 48° 50′ and sin 49° 0′ is .0019, one-tenth of which is .00019.

| | |
|---|---|
| sin 48° 50′ = .7528 | D. 1′ = 1.9 |
| 4 | 2 |
| .7532, *Ans.* | Corr. = 3.8 = 4, nearly. |

Ex. 2. Find the angle whose cos = .5506.

The difference between the next greater and next less functions, .5519 and .5495, is .0024; one-tenth of which is .00024.

Next greater cos = .5519; angle corresponding = 56° 30′.

.5506

D. 1′ = 2.4)13.0(5.41 = 5.4, nearly.

12 0

1 00

96

40

Result, 56° 35.4′.

### IV. USE OF THE TABLE OF NATURAL TANGENTS AND COTANGENTS.

This table (pages 22 and 23) gives the tangents and cotangents of all angles at intervals of 10 minutes from 0° to 90°; its use is similar to that of the table of natural sines and cosines.

## V. MORE ACCURATE METHOD FOR FINDING THE LOGARITHMIC FUNCTIONS OF ANGLES NEAR TO 0° OR 90°.

It was stated in Note VII., page 5, that in general the differences of the logarithmic functions are approximately proportional to the differences of their corresponding angles. It will be seen from the table that this is not the case with the logarithmic sines, tangents, and cotangents of angles near to 0°, nor with the logarithmic cosines, tangents, and cotangents of angles near to 90°.

Thus, the difference for 1′ in the case of the logarithmic sine or tangent of an angle between 40′ and 50′ is 96.9, while for an angle between 50′ and 1° it is 79.2.

A very accurate method for finding the logarithmic sine or tangent of an angle near to 0°, or the logarithmic cosine or cotangent of an angle near to 90°, is to first calculate the *natural function* by aid of the table of natural sines and cosines, or of natural tangents and cotangents, and then find the logarithm of the result.

To find the angle corresponding in similar cases, find the *number corresponding* to the logarithmic function, and then, by aid of the tables of natural functions, calculate the angle corresponding to the result.

**Ex. 1.** Find $\log \sin 0° 56'$.

From the table of natural sines and cosines, we obtain

$$\text{natural } \sin 0° 56' = .016289.$$

Whence, $$\log \sin 0° 56' = 8.2119 - 10.$$

This result is correct to the last place of decimals; by the ordinary method we should have obtained $8.2102 - 10$.

**Ex. 2.** Find the angle whose $\log \tan = 8.0302 - 10$.

The number corresponding to this logarithm is .01072.

From the table of natural tangents and cotangents the angle whose natural tangent is .01072 is 36.85′.

This is correct to the last place of decimals ; the ordinary method would have given 37.15′.

**Note XII.** To find with accuracy the log cotangent of an angle near to 0°, find the log tangent of the angle by the above method, and then subtract the result from 10 – 10. (See Note X., page 7.)

To find the angle corresponding to a log cotangent in a similar case, find the log tangent of the angle (Note X.), and then find the angle corresponding as above.

**Note XIII.** To find the log tangent of an angle near to 90°, find the log tangent of its *complement*, and subtract the result from 10 – 10. (See Note XII.)

To find the angle corresponding in a similar case, find the angle corresponding to its cologarithm, and take the complement of the result.

**Note XIV.** The more accurate method should be employed in finding the log sines, tangents, or cotangents of angles between 0° and 5°, or the log cosines, tangents, or cotangents of angles between 85° and 90°, and the angles corresponding in similar cases. For angles between 5° and 85° the ordinary method is sufficiently exact.

# FOUR PLACE LOGARITHMIC TABLES

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0000 | 0043 | 0086 | 0128 | 0170 | 0212 | 0253 | 0294 | 0334 | 0374 |
| 11 | 0414 | 0453 | 0492 | 0531 | 0569 | 0607 | 0645 | 0682 | 0719 | 0755 |
| 12 | 0792 | 0828 | 0864 | 0899 | 0934 | 0969 | 1004 | 1038 | 1072 | 1106 |
| 13 | 1139 | 1173 | 1206 | 1239 | 1271 | 1303 | 1335 | 1367 | 1399 | 1430 |
| 14 | 1461 | 1492 | 1523 | 1553 | 1584 | 1614 | 1644 | 1673 | 1703 | 1732 |
| 15 | 1761 | 1790 | 1818 | 1847 | 1875 | 1903 | 1931 | 1959 | 1987 | 2014 |
| 16 | 2041 | 2068 | 2095 | 2122 | 2148 | 2175 | 2201 | 2227 | 2253 | 2279 |
| 17 | 2304 | 2330 | 2355 | 2380 | 2405 | 2430 | 2455 | 2480 | 2504 | 2529 |
| 18 | 2553 | 2577 | 2601 | 2625 | 2648 | 2672 | 2695 | 2718 | 2742 | 2765 |
| 19 | 2788 | 2810 | 2833 | 2856 | 2878 | 2900 | 2923 | 2945 | 2967 | 2989 |
| 20 | 3010 | 3032 | 3054 | 3075 | 3096 | 3118 | 3139 | 3160 | 3181 | 3201 |
| 21 | 3222 | 3243 | 3263 | 3284 | 3304 | 3324 | 3345 | 3365 | 3385 | 3404 |
| 22 | 3424 | 3444 | 3464 | 3483 | 3502 | 3522 | 3541 | 3560 | 3579 | 3598 |
| 23 | 3617 | 3636 | 3655 | 3674 | 3692 | 3711 | 3729 | 3747 | 3766 | 3784 |
| 24 | 3802 | 3820 | 3838 | 3856 | 3874 | 3892 | 3909 | 3927 | 3945 | 3962 |
| 25 | 3979 | 3997 | 4014 | 4031 | 4048 | 4065 | 4082 | 4099 | 4116 | 4133 |
| 26 | 4150 | 4166 | 4183 | 4200 | 4216 | 4232 | 4249 | 4265 | 4281 | 4298 |
| 27 | 4314 | 4330 | 4346 | 4362 | 4378 | 4393 | 4409 | 4425 | 4440 | 4456 |
| 28 | 4472 | 4487 | 4502 | 4518 | 4533 | 4548 | 4564 | 4579 | 4594 | 4609 |
| 29 | 4624 | 4639 | 4654 | 4669 | 4683 | 4698 | 4713 | 4728 | 4742 | 4757 |
| 30 | 4771 | 4786 | 4800 | 4814 | 4829 | 4843 | 4857 | 4871 | 4886 | 4900 |
| 31 | 4914 | 4928 | 4942 | 4955 | 4969 | 4983 | 4997 | 5011 | 5024 | 5038 |
| 32 | 5051 | 5065 | 5079 | 5092 | 5105 | 5119 | 5132 | 5145 | 5159 | 5172 |
| 33 | 5185 | 5198 | 5211 | 5224 | 5237 | 5250 | 5263 | 5276 | 5289 | 5302 |
| 34 | 5315 | 5328 | 5340 | 5353 | 5366 | 5378 | 5391 | 5403 | 5416 | 5428 |
| 35 | 5441 | 5453 | 5465 | 5478 | 5490 | 5502 | 5514 | 5527 | 5539 | 5551 |
| 36 | 5563 | 5575 | 5587 | 5599 | 5611 | 5623 | 5635 | 5647 | 5658 | 5670 |
| 37 | 5682 | 5694 | 5705 | 5717 | 5729 | 5740 | 5752 | 5763 | 5775 | 5786 |
| 38 | 5798 | 5809 | 5821 | 5832 | 5843 | 5855 | 5866 | 5877 | 5888 | 5899 |
| 39 | 5911 | 5922 | 5933 | 5944 | 5955 | 5966 | 5977 | 5988 | 5999 | 6010 |
| 40 | 6021 | 6031 | 6042 | 6053 | 6064 | 6075 | 6085 | 6096 | 6107 | 6117 |
| 41 | 6128 | 6138 | 6149 | 6160 | 6170 | 6180 | 6191 | 6201 | 6212 | 6222 |
| 42 | 6232 | 6243 | 6253 | 6263 | 6274 | 6284 | 6294 | 6304 | 6314 | 6325 |
| 43 | 6335 | 6345 | 6355 | 6365 | 6375 | 6385 | 6395 | 6405 | 6415 | 6425 |
| 44 | 6435 | 6444 | 6454 | 6464 | 6474 | 6484 | 6493 | 6503 | 6513 | 6522 |
| 45 | 6532 | 6542 | 6551 | 6561 | 6571 | 6580 | 6590 | 6599 | 6609 | 6618 |
| 46 | 6628 | 6637 | 6646 | 6656 | 6665 | 6675 | 6684 | 6693 | 6702 | 6712 |
| 47 | 6721 | 6730 | 6739 | 6749 | 6758 | 6767 | 6776 | 6785 | 6794 | 6803 |
| 48 | 6812 | 6821 | 6830 | 6839 | 6848 | 6857 | 6866 | 6875 | 6884 | 6893 |
| 49 | 6902 | 6911 | 6920 | 6928 | 6937 | 6946 | 6955 | 6964 | 6972 | 6981 |
| 50 | 6990 | 6998 | 7007 | 7016 | 7024 | 7033 | 7042 | 7050 | 7059 | 7067 |
| 51 | 7076 | 7084 | 7093 | 7101 | 7110 | 7118 | 7126 | 7135 | 7143 | 7152 |
| 52 | 7160 | 7168 | 7177 | 7185 | 7193 | 7202 | 7210 | 7218 | 7226 | 7235 |
| 53 | 7243 | 7251 | 7259 | 7267 | 7275 | 7284 | 7292 | 7300 | 7308 | 7316 |
| 54 | 7324 | 7332 | 7340 | 7348 | 7356 | 7364 | 7372 | 7380 | 7388 | 7396 |
| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 7404 | 7412 | 7419 | 7427 | 7435 | 7443 | 7451 | 7459 | 7466 | 7474 |
| 56 | 7482 | 7490 | 7497 | 7505 | 7513 | 7520 | 7528 | 7536 | 7543 | 7551 |
| 57 | 7559 | 7566 | 7574 | 7582 | 7589 | 7597 | 7604 | 7612 | 7619 | 7627 |
| 58 | 7634 | 7642 | 7649 | 7657 | 7664 | 7672 | 7679 | 7686 | 7694 | 7701 |
| 59 | 7709 | 7716 | 7723 | 7731 | 7738 | 7745 | 7752 | 7760 | 7767 | 7774 |
| 60 | 7782 | 7789 | 7796 | 7803 | 7810 | 7818 | 7825 | 7832 | 7839 | 7846 |
| 61 | 7853 | 7860 | 7868 | 7875 | 7882 | 7889 | 7896 | 7903 | 7910 | 7917 |
| 62 | 7924 | 7931 | 7938 | 7945 | 7952 | 7959 | 7966 | 7973 | 7980 | 7987 |
| 63 | 7993 | 8000 | 8007 | 8014 | 8021 | 8028 | 8035 | 8041 | 8048 | 8055 |
| 64 | 8062 | 8069 | 8075 | 8082 | 8089 | 8096 | 8102 | 8109 | 8116 | 8122 |
| 65 | 8129 | 8136 | 8142 | 8149 | 8156 | 8162 | 8169 | 8176 | 8182 | 8189 |
| 66 | 8195 | 8202 | 8209 | 8215 | 8222 | 8228 | 8235 | 8241 | 8248 | 8254 |
| 67 | 8261 | 8267 | 8274 | 8280 | 8287 | 8293 | 8299 | 8306 | 8312 | 8319 |
| 68 | 8325 | 8331 | 8338 | 8344 | 8351 | 8357 | 8363 | 8370 | 8376 | 8382 |
| 69 | 8388 | 8395 | 8401 | 8407 | 8414 | 8420 | 8426 | 8432 | 8439 | 8445 |
| 70 | 8451 | 8457 | 8463 | 8470 | 8476 | 8482 | 8488 | 8494 | 8500 | 8506 |
| 71 | 8513 | 8519 | 8525 | 8531 | 8537 | 8543 | 8549 | 8555 | 8561 | 8567 |
| 72 | 8573 | 8579 | 8585 | 8591 | 8597 | 8603 | 8609 | 8615 | 8621 | 8627 |
| 73 | 8633 | 8639 | 8645 | 8651 | 8657 | 8663 | 8669 | 8675 | 8681 | 8686 |
| 74 | 8692 | 8698 | 8704 | 8710 | 8716 | 8722 | 8727 | 8733 | 8739 | 8745 |
| 75 | 8751 | 8756 | 8762 | 8768 | 8774 | 8779 | 8785 | 8791 | 8797 | 8802 |
| 76 | 8808 | 8814 | 8820 | 8825 | 8831 | 8837 | 8842 | 8848 | 8854 | 8859 |
| 77 | 8865 | 8871 | 8876 | 8882 | 8887 | 8893 | 8899 | 8904 | 8910 | 8915 |
| 78 | 8921 | 8927 | 8932 | 8938 | 8943 | 8949 | 8954 | 8960 | 8965 | 8971 |
| 79 | 8976 | 8982 | 8987 | 8993 | 8998 | 9004 | 9009 | 9015 | 9020 | 9025 |
| 80 | 9031 | 9036 | 9042 | 9047 | 9053 | 9058 | 9063 | 9069 | 9074 | 9079 |
| 81 | 9085 | 9090 | 9096 | 9101 | 9106 | 9112 | 9117 | 9122 | 9128 | 9133 |
| 82 | 9138 | 9143 | 9149 | 9154 | 9159 | 9165 | 9170 | 9175 | 9180 | 9186 |
| 83 | 9191 | 9196 | 9201 | 9206 | 9212 | 9217 | 9222 | 9227 | 9232 | 9238 |
| 84 | 9243 | 9248 | 9253 | 9258 | 9263 | 9269 | 9274 | 9279 | 9284 | 9289 |
| 85 | 9294 | 9299 | 9304 | 9309 | 9315 | 9320 | 9325 | 9330 | 9335 | 9340 |
| 86 | 9345 | 9350 | 9355 | 9360 | 9365 | 9370 | 9375 | 9380 | 9385 | 9390 |
| 87 | 9395 | 9400 | 9405 | 9410 | 9415 | 9420 | 9425 | 9430 | 9435 | 9440 |
| 88 | 9445 | 9450 | 9455 | 9460 | 9465 | 9469 | 9474 | 9479 | 9484 | 9489 |
| 89 | 9494 | 9499 | 9504 | 9509 | 9513 | 9518 | 9523 | 9528 | 9533 | 9538 |
| 90 | 9542 | 9547 | 9552 | 9557 | 9562 | 9566 | 9571 | 9576 | 9581 | 9586 |
| 91 | 9590 | 9595 | 9600 | 9605 | 9609 | 9614 | 9619 | 9624 | 9628 | 9633 |
| 92 | 9638 | 9643 | 9647 | 9652 | 9657 | 9661 | 9666 | 9671 | 9675 | 9680 |
| 93 | 9685 | 9689 | 9694 | 9699 | 9703 | 9708 | 9713 | 9717 | 9722 | 9727 |
| 94 | 9731 | 9736 | 9741 | 9745 | 9750 | 9754 | 9759 | 9763 | 9768 | 9773 |
| 95 | 9777 | 9782 | 9786 | 9791 | 9795 | 9800 | 9805 | 9809 | 9814 | 9818 |
| 96 | 9823 | 9827 | 9832 | 9836 | 9841 | 9845 | 9850 | 9854 | 9859 | 9863 |
| 97 | 9868 | 9872 | 9877 | 9881 | 9886 | 9890 | 9894 | 9899 | 9903 | 9908 |
| 98 | 9912 | 9917 | 9921 | 9926 | 9930 | 9934 | 9939 | 9943 | 9948 | 9952 |
| 99 | 9956 | 9961 | 9965 | 9969 | 9974 | 9978 | 9983 | 9987 | 9991 | 9996 |
| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 0° 0′ | −∞ | | 10.0000 | | −∞ | | ∞ | 90° 0′ |
| 0° 10′ | 7.4637 | | .0000 | .0 | 7.4637 | | 2.5363 | 89° 50′ |
| 0° 20′ | .7648 | 301.1 | .0000 | .0 | .7648 | 301.1 | .2352 | 89° 40′ |
| 0° 30′ | .9408 | 176.0 | .0000 | .0 | .9409 | 176.1 | .0591 | 89° 30′ |
| 0° 40′ | 8.0658 | 125.0 | .0000 | .0 | 8.0658 | 124.9 | 1.9342 | 89° 20′ |
| 0° 50′ | .1627 | 96.9 | .0000 | .0 | .1627 | 96.9 | .8373 | 89° 10′ |
| 1° 0′ | 8.2419 | 79.2 | 9.9999 | .1 | 8.2419 | 79.2 | 1.7581 | 89° 0′ |
| 1° 10′ | .3088 | 66.9 | .9999 | .0 | .3089 | 67.0 | .6911 | 88° 50′ |
| 1° 20′ | .3668 | 58.0 | .9999 | .0 | .3669 | 58.0 | .6331 | 88° 40′ |
| 1° 30′ | .4179 | 51.1 | .9999 | .0 | .4181 | 51.2 | .5819 | 88° 30′ |
| 1° 40′ | .4637 | 45.8 | .9998 | .1 | .4638 | 45.7 | .5362 | 88° 20′ |
| 1° 50′ | .5050 | 41.3 | .9998 | .0 | .5053 | 41.5 | .4947 | 88° 10′ |
| 2° 0′ | 8.5428 | 37.8 | 9.9997 | .1 | 8.5431 | 37.8 | 1.4569 | 88° 0′ |
| 2° 10′ | .5776 | 34.8 | .9997 | .0 | .5779 | 34.8 | .4221 | 87° 50′ |
| 2° 20′ | .6097 | 32.1 | .9996 | .1 | .6101 | 32.2 | .3899 | 87° 40′ |
| 2° 30′ | .6397 | 30.0 | .9996 | .0 | .6401 | 30.0 | .3599 | 87° 30′ |
| 2° 40′ | .6677 | 28.0 | .9995 | .1 | .6682 | 28.1 | .3318 | 87° 20′ |
| 2° 50′ | .6940 | 26.3 | .9995 | .0 | .6945 | 26.3 | .3055 | 87° 10′ |
| 3° 0′ | 8.7188 | 24.8 | 9.9994 | .1 | 8.7194 | 24.9 | 1.2806 | 87° 0′ |
| 3° 10′ | .7423 | 23.5 | .9993 | .1 | .7429 | 23.5 | .2571 | 86° 50′ |
| 3° 20′ | .7645 | 22.2 | .9993 | .0 | .7652 | 22.3 | .2348 | 86° 40′ |
| 3° 30′ | .7857 | 21.2 | .9992 | .1 | .7865 | 21.3 | .2135 | 86° 30′ |
| 3° 40′ | .8059 | 20.2 | .9991 | .1 | .8067 | 20.2 | .1933 | 86° 20′ |
| 3° 50′ | .8251 | 19.2 | .9990 | .1 | .8261 | 19.4 | .1739 | 86° 10′ |
| 4° 0′ | 8.8436 | 18.5 | 9.9989 | .1 | 8.8446 | 18.5 | 1.1554 | 86° 0′ |
| 4° 10′ | .8613 | 17.7 | .9989 | .0 | .8624 | 17.8 | .1376 | 85° 50′ |
| 4° 20′ | .8783 | 17.0 | .9988 | .1 | .8795 | 17.1 | .1205 | 85° 40′ |
| 4° 30′ | .8946 | 16.3 | .9987 | .1 | .8960 | 16.5 | .1040 | 85° 30′ |
| 4° 40′ | .9104 | 15.8 | .9986 | .1 | .9118 | 15.8 | .0882 | 85° 20′ |
| 4° 50′ | .9256 | 15.2 | .9985 | .1 | .9272 | 15.4 | .0728 | 85° 10′ |
| 5° 0′ | 8.9403 | 14.7 | 9.9983 | .2 | 8.9420 | 14.8 | 1.0580 | 85° 0′ |
| 5° 10′ | .9545 | 14.2 | .9982 | .1 | .9563 | 14.3 | .0437 | 84° 50′ |
| 5° 20′ | .9682 | 13.7 | .9981 | .1 | .9701 | 13.8 | .0299 | 84° 40′ |
| 5° 30′ | .9816 | 13.4 | .9980 | .1 | .9836 | 13.5 | .0164 | 84° 30′ |
| 5° 40′ | .9945 | 12.9 | .9979 | .1 | .9966 | 13.0 | .0034 | 84° 20′ |
| 5° 50′ | 9.0070 | 12.5 | .9977 | .2 | 9.0093 | 12.7 | 0.9907 | 84° 10′ |
| 6° 0′ | 9.0192 | 12.2 | 9.9976 | .1 | 9.0216 | 12.3 | 0.9784 | 84° 0′ |
| 6° 10′ | .0311 | 11.9 | .9975 | .1 | .0336 | 12.0 | .9664 | 83° 50′ |
| 6° 20′ | .0426 | 11.5 | .9973 | .2 | .0453 | 11.7 | .9547 | 83° 40′ |
| 6° 30′ | .0539 | 11.3 | .9972 | .1 | .0567 | 11.4 | .9433 | 83° 30′ |
| 6° 40′ | .0648 | 10.9 | .9971 | .1 | .0678 | 11.1 | .9322 | 83° 20′ |
| 6° 50′ | .0755 | 10.7 | .9969 | .2 | .0786 | 10.8 | .9214 | 83° 10′ |
| 7° 0′ | 9.0859 | 10.4 | 9.9968 | .1 | 9.0891 | 10.5 | 0.9109 | 83° 0′ |
| 7° 10′ | .0961 | 10.2 | .9966 | .2 | .0995 | 10.4 | .9005 | 82° 50′ |
| 7° 20′ | .1060 | 9.9 | .9964 | .2 | .1096 | 10.1 | .8904 | 82° 40′ |
| 7° 30′ | .1157 | 9.7 | .9963 | .1 | .1194 | 9.8 | .8806 | 82° 30′ |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 7° 30′ | 9.1157 | 9.5 | 9.9963 | .2 | 9.1194 | 9.7 | 0.8806 | 82° 30′ |
| 7° 40′ | .1252 | 9.3 | .9961 | .2 | .1291 | 9.4 | .8709 | 82° 20′ |
| 7° 50′ | .1345 | 9.1 | .9959 | .1 | .1385 | 9.3 | .8615 | 82° 10′ |
| **8° 0′** | 9.1436 | 8.9 | 9.9958 | .2 | 9.1478 | 9.1 | 0.8522 | **82° 0′** |
| 8° 10′ | .1525 | 8.7 | .9956 | .2 | .1569 | 8.9 | .8431 | 81° 50′ |
| 8° 20′ | .1612 | 8.5 | .9954 | .2 | .1658 | 8.7 | .8342 | 81° 40′ |
| 8° 30′ | .1697 | 8.4 | .9952 | .2 | .1745 | 8.6 | .8255 | 81° 30′ |
| 8° 40′ | .1781 | 8.2 | .9950 | .2 | .1831 | 8.4 | .8169 | 81° 20′ |
| 8° 50′ | .1863 | 8.0 | .9948 | .2 | .1915 | 8.2 | .8085 | 81° 10′ |
| **9° 0′** | 9.1943 | 7.9 | 9.9946 | .2 | 9.1997 | 8.1 | 0.8003 | **81° 0′** |
| 9° 10′ | .2022 | 7.8 | .9944 | .2 | .2078 | 8.0 | .7922 | 80° 50′ |
| 9° 20′ | .2100 | 7.6 | .9942 | .2 | .2158 | 7.8 | .7842 | 80° 40′ |
| 9° 30′ | .2176 | 7.5 | .9940 | .2 | .2236 | 7.7 | .7764 | 80° 30′ |
| 9° 40′ | .2251 | 7.3 | .9938 | .2 | .2313 | 7.6 | .7687 | 80° 20′ |
| 9° 50′ | .2324 | 7.3 | .9936 | .2 | .2389 | 7.4 | .7611 | 80° 10′ |
| **10° 0′** | 9.2397 | 7.1 | 9.9934 | .3 | 9.2463 | 7.3 | 0.7537 | **80° 0′** |
| 10° 10′ | .2468 | 7.0 | .9931 | .2 | .2536 | 7.3 | .7464 | 79° 50′ |
| 10° 20′ | .2538 | 6.8 | .9929 | .2 | .2609 | 7.1 | .7391 | 79° 40′ |
| 10° 30′ | .2606 | 6.8 | .9927 | .3 | .2680 | 7.0 | .7320 | 79° 30′ |
| 10° 40′ | .2674 | 6.6 | .9924 | .2 | .2750 | 6.9 | .7250 | 79° 20′ |
| 10° 50′ | .2740 | 6.6 | .9922 | .3 | .2819 | 6.8 | .7181 | 79° 10′ |
| **11° 0′** | 9.2806 | 6.4 | 9.9919 | .2 | 9.2887 | 6.6 | 0.7113 | **79° 0′** |
| 11° 10′ | .2870 | 6.4 | .9917 | .3 | .2953 | 6.7 | .7047 | 78° 50′ |
| 11° 20′ | .2934 | 6.3 | .9914 | .2 | .3020 | 6.5 | .6980 | 78° 40′ |
| 11° 30′ | .2997 | 6.1 | .9912 | .3 | .3085 | 6.4 | .6915 | 78° 30′ |
| 11° 40′ | .3058 | 6.1 | .9909 | .2 | .3149 | 6.3 | .6851 | 78° 20′ |
| 11° 50′ | .3119 | 6.0 | .9907 | .3 | .3212 | 6.3 | .6788 | 78° 10′ |
| **12° 0′** | 9.3179 | 5.9 | 9.9904 | .3 | 9.3275 | 6.1 | 0.6725 | **78° 0′** |
| 12° 10′ | .3238 | 5.8 | .9901 | .2 | .3336 | 6.1 | .6664 | 77° 50′ |
| 12° 20′ | .3296 | 5.7 | .9899 | .3 | .3397 | 6.1 | .6603 | 77° 40′ |
| 12° 30′ | .3353 | 5.7 | .9896 | .3 | .3458 | 5.9 | .6542 | 77° 30′ |
| 12° 40′ | .3410 | 5.6 | .9893 | .3 | .3517 | 5.9 | .6483 | 77° 20′ |
| 12° 50′ | .3466 | 5.5 | .9890 | .3 | .3576 | 5.8 | .6424 | 77° 10′ |
| **13° 0′** | 9.3521 | 5.4 | 9.9887 | .3 | 9.3634 | 5.7 | 0.6366 | **77° 0′** |
| 13° 10′ | .3575 | 5.4 | .9884 | .3 | .3691 | 5.7 | .6309 | 76° 50′ |
| 13° 20′ | .3629 | 5.3 | .9881 | .3 | .3748 | 5.6 | .6252 | 76° 40′ |
| 13° 30′ | .3682 | 5.2 | .9878 | .3 | .3804 | 5.5 | .6196 | 76° 30′ |
| 13° 40′ | .3734 | 5.2 | .9875 | .3 | .3859 | 5.5 | .6141 | 76° 20′ |
| 13° 50′ | .3786 | 5.1 | .9872 | .3 | .3914 | 5.4 | .6086 | 76° 10′ |
| **14° 0′** | 9.3837 | 5.0 | 9.9869 | .3 | 9.3968 | 5.3 | 0.6032 | **76° 0′** |
| 14° 10′ | .3887 | 5.0 | .9866 | .3 | .4021 | 5.3 | .5979 | 75° 50′ |
| 14° 20′ | .3937 | 4.9 | .9863 | .4 | .4074 | 5.3 | .5926 | 75° 40′ |
| 14° 30′ | .3986 | 4.9 | .9859 | .3 | .4127 | 5.1 | .5873 | 75° 30′ |
| 14° 40′ | .4035 | 4.8 | .9856 | .3 | .4178 | 5.2 | .5822 | 75° 20′ |
| 14° 50′ | .4083 | 4.7 | .9853 | .4 | .4230 | 5.1 | .5770 | 75° 10′ |
| **15° 0′** | 9.4130 | | 9.9849 | | 9.4281 | | 0.5719 | **75° 0′** |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 15° 0′ | 9.4130 | 4.7 | 9.9849 | .3 | 9.4281 | 5.0 | 0.5719 | 75° 0′ |
| 15° 10′ | .4177 | 4.6 | .9846 | .3 | .4331 | 5.0 | .5669 | 74° 50′ |
| 15° 20′ | .4223 | 4.6 | .9843 | .4 | .4381 | 4.9 | .5619 | 74° 40′ |
| 15° 30′ | .4269 | 4.5 | .9839 | .3 | .4430 | 4.9 | .5570 | 74° 30′ |
| 15° 40′ | .4314 | 4.5 | .9836 | .4 | .4479 | 4.8 | .5521 | 74° 20′ |
| 15° 50′ | .4359 | 4.4 | .9832 | .4 | .4527 | 4.8 | .5473 | 74° 10′ |
| 16° 0′ | 9.4403 | 4.4 | 9.9828 | .3 | 9.4575 | 4.7 | 0.5425 | 74° 0′ |
| 16° 10′ | .4447 | 4.4 | .9825 | .4 | .4622 | 4.7 | .5378 | 73° 50′ |
| 16° 20′ | .4491 | 4.2 | .9821 | .4 | .4669 | 4.7 | .5331 | 73° 40′ |
| 16° 30′ | .4533 | 4.3 | .9817 | .3 | .4716 | 4.6 | .5284 | 73° 30′ |
| 16° 40′ | .4576 | 4.2 | .9814 | .4 | .4762 | 4.6 | .5238 | 73° 20′ |
| 16° 50′ | .4618 | 4.1 | .9810 | .4 | .4808 | 4.5 | .5192 | 73° 10′ |
| 17° 0′ | 9.4659 | 4.1 | 9.9806 | .4 | 9.4853 | 4.5 | 0.5147 | 73° 0′ |
| 17° 10′ | .4700 | 4.1 | .9802 | .4 | .4898 | 4.5 | .5102 | 72° 50′ |
| 17° 20′ | .4741 | 4.0 | .9798 | .4 | .4943 | 4.4 | .5057 | 72° 40′ |
| 17° 30′ | .4781 | 4.0 | .9794 | .4 | .4987 | 4.4 | .5013 | 72° 30′ |
| 17° 40′ | .4821 | 4.0 | .9790 | .4 | .5031 | 4.4 | .4969 | 72° 20′ |
| 17° 50′ | .4861 | 3.9 | .9786 | .4 | .5075 | 4.3 | .4925 | 72° 10′ |
| 18° 0′ | 9.4900 | 3.9 | 9.9782 | .4 | 9.5118 | 4.3 | 0.4882 | 72° 0′ |
| 18° 10′ | .4939 | 3.8 | .9778 | .4 | .5161 | 4.2 | .4839 | 71° 50′ |
| 18° 20′ | .4977 | 3.8 | .9774 | .4 | .5203 | 4.2 | .4797 | 71° 40′ |
| 18° 30′ | .5015 | 3.7 | .9770 | .5 | .5245 | 4.2 | .4755 | 71° 30′ |
| 18° 40′ | .5052 | 3.8 | .9765 | .4 | .5287 | 4.2 | .4713 | 71° 20′ |
| 18° 50′ | .5090 | 3.6 | .9761 | .4 | .5329 | 4.1 | .4671 | 71° 10′ |
| 19° 0′ | 9.5126 | 3.7 | 9.9757 | .5 | 9.5370 | 4.1 | 0.4630 | 71° 0′ |
| 19° 10′ | .5163 | 3.6 | .9752 | .4 | .5411 | 4.0 | .4589 | 70° 50′ |
| 19° 20′ | .5199 | 3.6 | .9748 | .5 | .5451 | 4.0 | .4549 | 70° 40′ |
| 19° 30′ | .5235 | 3.5 | .9743 | .4 | .5491 | 4.0 | .4509 | 70° 30′ |
| 19° 40′ | .5270 | 3.6 | .9739 | .5 | .5531 | 4.0 | .4469 | 70° 20′ |
| 19° 50′ | .5306 | 3.5 | .9734 | .4 | .5571 | 4.0 | .4429 | 70° 10′ |
| 20° 0′ | 9.5341 | 3.4 | 9.9730 | .5 | 9.5611 | 3.9 | 0.4389 | 70° 0′ |
| 20° 10′ | .5375 | 3.4 | .9725 | .4 | .5650 | 3.9 | .4350 | 69° 50′ |
| 20° 20′ | .5409 | 3.4 | .9721 | .5 | .5689 | 3.8 | .4311 | 69° 40′ |
| 20° 30′ | .5443 | 3.4 | .9716 | .5 | .5727 | 3.9 | .4273 | 69° 30′ |
| 20° 40′ | .5477 | 3.3 | .9711 | .5 | .5766 | 3.8 | .4234 | 69° 20′ |
| 20° 50′ | .5510 | 3.3 | .9706 | .4 | .5804 | 3.8 | .4196 | 69° 10′ |
| 21° 0 | 9.5543 | 3.3 | 9.9702 | .5 | 9.5842 | 3.7 | 0.4158 | 69° 0′ |
| 21° 10′ | .5576 | 3.3 | .9697 | .5 | .5879 | 3.8 | 4121 | 68° 50′ |
| 21° 20′ | .5609 | 3.2 | .9692 | .5 | .5917 | 3.7 | .4083 | 68° 40′ |
| 21° 30′ | .5641 | 3.2 | .9687 | .5 | .5954 | 3.7 | .4046 | 68° 30′ |
| 21° 40′ | .5673 | 3.1 | .9682 | .5 | .5991 | 3.7 | .4009 | 68° 20′ |
| 21° 50′ | .5704 | 3.2 | .9677 | .5 | .6028 | 3.6 | .3972 | 68° 10′ |
| 22° 0′ | 9.5736 | 3.1 | 9.9672 | .5 | 9.6064 | 3.6 | 0.3936 | 68° 0′ |
| 22° 10′ | .5767 | 3.1 | .9667 | .6 | .6100 | 3.6 | .3900 | 67° 50′ |
| 22° 20′ | .5798 | 3.0 | .9661 | .5 | .6136 | 3.6 | .3864 | 67° 40′ |
| 22° 30′ | .5828 | | .9656 | | .6172 | | .3828 | 67° 30′ |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 22° 30′ | 9.5828 | | 9.9656 | | 9.6172 | | 0.3828 | 67° 30′ |
| 22° 40′ | .5859 | 3.1 | .9651 | .5 | .6208 | 3.6 | .3792 | 67° 20′ |
| 22° 50′ | .5889 | 3.0 | .9646 | .5 | .6243 | 3.5 | .3757 | 67° 10′ |
| **23° 0′** | 9.5919 | 3.0 | 9.9640 | .6 | 9.6279 | 3.6 | 0.3721 | **67° 0′** |
| 23° 10′ | .5948 | 2.9 | .9635 | .5 | .6314 | 3.5 | .3686 | 66° 50′ |
| 23° 20′ | .5978 | 3.0 | .9629 | .6 | .6348 | 3.4 | .3652 | 66° 40′ |
| 23° 30′ | .6007 | 2.9 | .9624 | .5 | .6383 | 3.5 | .3617 | 66° 30′ |
| 23° 40′ | .6036 | 2.9 | .9618 | .6 | .6417 | 3.4 | .3583 | 66° 20′ |
| 23° 50′ | .6065 | 2.9 | .9613 | .5 | .6452 | 3.5 | .3548 | 66° 10′ |
| **24° 0′** | 9.6093 | 2.8 | 9.9607 | .6 | 9.6486 | 3.4 | 0.3514 | **66° 0′** |
| 24° 10′ | .6121 | 2.8 | .9602 | .5 | .6520 | 3.4 | .3480 | 65° 50′ |
| 24° 20′ | .6149 | 2.8 | .9596 | .6 | .6553 | 3.3 | .3447 | 65° 40′ |
| 24° 30′ | .6177 | 2.8 | .9590 | .6 | .6587 | 3.4 | .3413 | 65° 30′ |
| 24° 40′ | .6205 | 2.7 | .9584 | .6 | .6620 | 3.3 | .3380 | 65° 20′ |
| 24° 50′ | .6232 | 2.7 | .9579 | .5 | .6654 | 3.4 | .3346 | 65° 10′ |
| **25° 0′** | 9.6259 | 2.7 | 9.9573 | .6 | 9.6687 | 3.3 | 0.3313 | **65° 0′** |
| 25° 10′ | .6286 | 2.7 | .9567 | .6 | .6720 | 3.3 | .3280 | 64° 50′ |
| 25° 20′ | .6313 | 2.7 | .9561 | .6 | .6752 | 3.2 | .3248 | 64° 40′ |
| 25° 30′ | .6340 | 2.6 | .9555 | .6 | .6785 | 3.3 | .3215 | 64° 30′ |
| 25° 40′ | .6366 | 2.6 | .9549 | .6 | .6817 | 3.2 | .3183 | 64° 20′ |
| 25° 50′ | .6392 | 2.6 | .9543 | .6 | .6850 | 3.3 | .3150 | 64° 10′ |
| **26° 0′** | 9.6418 | 2.6 | 9.9537 | .7 | 9.6882 | 3.2 | 0.3118 | **64° 0′** |
| 26° 10′ | .6444 | 2.6 | .9530 | .6 | .6914 | 3.2 | .3086 | 63° 50′ |
| 26° 20′ | .6470 | 2.5 | .9524 | .6 | .6946 | 3.1 | .3054 | 63° 40′ |
| 26° 30′ | .6495 | 2.6 | .9518 | .6 | .6977 | 3.2 | .3023 | 63° 30′ |
| 26° 40′ | .6521 | 2.5 | .9512 | .7 | .7009 | 3.1 | .2991 | 63° 20′ |
| 26° 50′ | .6546 | 2.4 | .9505 | .6 | .7040 | 3.2 | .2960 | 63° 10′ |
| **27° 0′** | 9.6570 | 2.5 | 9.9499 | .7 | 9.7072 | 3.1 | 0.2928 | **63° 0′** |
| 27° 10′ | .6595 | 2.5 | .9492 | .6 | .7103 | 3.1 | .2897 | 62° 50′ |
| 27° 20′ | .6620 | 2.4 | .9486 | .7 | .7134 | 3.1 | .2866 | 62° 40′ |
| 27° 30′ | .6644 | 2.4 | .9479 | .6 | .7165 | 3.1 | .2835 | 62° 30′ |
| 27° 40′ | .6668 | 2.4 | .9473 | .7 | .7196 | 3.0 | .2804 | 62° 20′ |
| 27° 50′ | .6692 | 2.4 | .9466 | .7 | .7226 | 3.1 | .2774 | 62° 10′ |
| **28° 0′** | 9.6716 | 2.4 | 9.9459 | .6 | 9.7257 | 3.0 | 0.2743 | **62° 0′** |
| 28° 10′ | .6740 | 2.3 | .9453 | .7 | .7287 | 3.0 | .2713 | 61° 50′ |
| 28° 20′ | .6763 | 2.4 | .9446 | .7 | .7317 | 3.1 | .2683 | 61° 40′ |
| 28° 30′ | .6787 | 2.3 | .9439 | .7 | .7348 | 3.0 | .2652 | 61° 30′ |
| 28° 40′ | .6810 | 2.3 | .9432 | .7 | .7378 | 3.0 | .2622 | 61° 20′ |
| 28° 50′ | .6833 | 2.3 | .9425 | .7 | .7408 | 3.0 | .2592 | 61° 10′ |
| **29° 0′** | 9.6856 | 2.2 | 9.9418 | .7 | 9.7438 | 2.9 | 0.2562 | **61 °0′** |
| 29° 10′ | .6878 | 2.3 | .9411 | .7 | .7467 | 3.0 | .2533 | 60° 50′ |
| 29° 20′ | .6901 | 2.2 | .9404 | .7 | .7497 | 2.9 | .2503 | 60° 40′ |
| 29° 30′ | .6923 | 2.3 | .9397 | .7 | .7526 | 3.0 | .2474 | 60° 30′ |
| 29° 40′ | .6946 | 2.2 | .9390 | .7 | .7556 | 2.9 | .2444 | 60° 20′ |
| 29° 50′ | .6968 | 2.2 | .9383 | .8 | .7585 | 2.9 | .2415 | 60° 10′ |
| **30° 0′** | 9.6990 | | 9.9375 | | 9.7614 | | 0.2386 | **60° 0′** |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 30° 0′ | 9.6990 | 2.2 | 9.9375 | .7 | 9.7614 | 3.0 | 0.2386 | 60° 0′ |
| 30° 10′ | .7012 | 2.1 | .9368 | .7 | .7644 | 2.9 | .2356 | 59° 50′ |
| 30° 20′ | .7033 | 2.2 | .9361 | .8 | .7673 | 2.8 | .2327 | 59° 40′ |
| 30° 30′ | .7055 | 2.1 | .9353 | .7 | .7701 | 2.9 | .2299 | 59° 30′ |
| 30° 40′ | 7076 | 2.1 | .9346 | .8 | .7730 | 2.9 | .2270 | 59° 20′ |
| 30° 50′ | .7097 | 2.1 | .9338 | .7 | .7759 | 2.9 | .2241 | 59° 10′ |
| 31° 0′ | 9.7118 | 2.1 | 9.9331 | .8 | 9.7788 | 2.8 | 0.2212 | 59° 0′ |
| 31° 10′ | 7139 | 2.1 | .9323 | .8 | .7816 | 2.9 | .2184 | 58° 50′ |
| 31° 20′ | .7160 | 2.1 | .9315 | .7 | .7845 | 2.8 | .2155 | 58° 40′ |
| 31° 30′ | .7181 | 2.0 | .9308 | .8 | .7873 | 2.9 | .2127 | 58° 30′ |
| 31° 40′ | .7201 | 2.1 | .9300 | .8 | .7902 | 2.8 | .2098 | 58° 20′ |
| 31° 50′ | .7222 | 2.0 | .9292 | .8 | .7930 | 2.8 | .2070 | 58° 10′ |
| 32° 0′ | 9.7242 | 2.0 | 9.9284 | .8 | 9.7958 | 2.8 | 0.2042 | 58° 0′ |
| 32° 10′ | .7262 | 2.0 | .9276 | .8 | .7986 | 2.8 | .2014 | 57° 50′ |
| 32° 20′ | .7282 | 2.0 | .9268 | .8 | .8014 | 2.8 | .1986 | 57° 40′ |
| 32° 30′ | .7302 | 2.0 | .9260 | .8 | .8042 | 2.8 | .1958 | 57° 30′ |
| 32° 40′ | .7322 | 2.0 | .9252 | .8 | .8070 | 2.7 | .1930 | 57° 20′ |
| 32° 50′ | .7342 | 1.9 | .9244 | .8 | .8097 | 2.8 | .1903 | 57° 10′ |
| 33° 0′ | 9.7361 | 1.9 | 9.9236 | .8 | 9.8125 | 2.8 | 0.1875 | 57° 0′ |
| 33° 10′ | .7380 | 2.0 | .9228 | .9 | .8153 | 2.7 | .1847 | 56° 50′ |
| 33° 20′ | .7400 | 1.9 | .9219 | .8 | .8180 | 2.8 | .1820 | 56° 40′ |
| 33° 30′ | .7419 | 1.9 | .9211 | .8 | .8208 | 2.7 | .1792 | 56° 30′ |
| 33° 40′ | .7438 | 1.9 | .9203 | .9 | .8235 | 2.8 | .1765 | 56° 20′ |
| 33° 50′ | .7457 | 1.9 | .9194 | .8 | .8263 | 2.7 | .1737 | 56° 10′ |
| 34° 0′ | 9.7476 | 1.8 | 9.9186 | .9 | 9.8290 | 2.7 | 0.1710 | 56° 0′ |
| 34° 10′ | .7494 | 1.9 | .9177 | .8 | .8317 | 2.7 | .1683 | 55° 50′ |
| 34° 20′ | .7513 | 1.8 | .9169 | .9 | .8344 | 2.7 | .1656 | 55° 40′ |
| 34° 30′ | .7531 | 1.9 | .9160 | .9 | .8371 | 2.7 | .1629 | 55° 30′ |
| 34° 40′ | .7550 | 1.8 | .9151 | .9 | .8398 | 2.7 | .1602 | 55° 20′ |
| 34° 50′ | .7568 | 1.8 | .9142 | .8 | .8425 | 2.7 | .1575 | 55° 10′ |
| 35° 0′ | 9.7586 | 1.8 | 9.9134 | .9 | 9.8452 | 2.7 | 0.1548 | 55° 0′ |
| 35° 10′ | .7604 | 1.8 | .9125 | .9 | .8479 | 2.7 | .1521 | 54° 50′ |
| 35° 20′ | .7622 | 1.8 | .9116 | .9 | .8506 | 2.7 | .1494 | 54° 40′ |
| 35° 30′ | .7640 | 1.7 | .9107 | .9 | .8533 | 2.6 | .1467 | 54° 30′ |
| 35° 40′ | .7657 | 1.8 | .9098 | .9 | .8559 | 2.7 | .1441 | 54° 20′ |
| 35° 50′ | .7675 | 1.7 | .9089 | .9 | .8586 | 2.7 | .1414 | 54° 10′ |
| 36° 0′ | 9.7692 | 1.8 | 9.9080 | 1.0 | 9.8613 | 2.6 | 0.1387 | 54° 0′ |
| 36° 10′ | .7710 | 1.7 | .9070 | .9 | .8639 | 2.7 | .1361 | 53° 50′ |
| 36° 20′ | .7727 | 1.7 | .9061 | .9 | .8666 | 2.6 | .1334 | 53° 40′ |
| 36° 30′ | .7744 | 1.7 | .9052 | 1.0 | .8692 | 2.6 | .1308 | 53° 30′ |
| 36° 40′ | .7761 | 1.7 | .9042 | .9 | .8718 | 2.7 | .1282 | 53° 20′ |
| 36° 50′ | .7778 | 1.7 | .9033 | 1.0 | .8745 | 2.6 | .1255 | 53° 10′ |
| 37° 0′ | 9.7795 | 1.6 | 9.9023 | .9 | 9.8771 | 2.6 | 0.1229 | 53° 0 |
| 37° 10′ | .7811 | 1.7 | .9014 | 1.0 | .8797 | 2.7 | .1203 | 52° 50 |
| 37° 20′ | .7828 | 1.6 | .9004 | .9 | .8824 | 2.6 | .1176 | 52° 40′ |
| 37° 30′ | .7844 | | .8995 | | .8850 | | .1150 | 52° 30′ |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| Angle. | Sin. | D. 1′. | Cos. | D. 1′. | Tan. | D. 1′. | Cot. | |
|---|---|---|---|---|---|---|---|---|
| 37° 30′ | 9.7844 | 1.7 | 9.8995 | 1.0 | 9.8850 | 2.6 | 0.1150 | 52° 30′ |
| 37° 40′ | .7861 | 1.6 | .8985 | 1.0 | .8876 | 2.6 | .1124 | 52° 20′ |
| 37° 50′ | .7877 | 1.6 | .8975 | 1.0 | .8902 | 2.6 | .1098 | 52° 10′ |
| **38° 0′** | 9.7893 | 1.7 | 9.8965 | 1.0 | 9.8928 | 2.6 | 0.1072 | **52° 0′** |
| 38° 10′ | .7910 | 1.6 | .8955 | 1.0 | .8954 | 2.6 | .1046 | 51° 50′ |
| 38° 20′ | .7926 | 1.5 | .8945 | 1.0 | .8980 | 2.6 | .1020 | 51° 40′ |
| 38° 30′ | .7941 | 1.6 | .8935 | 1.0 | .9006 | 2.6 | .0994 | 51° 30′ |
| 38° 40′ | .7957 | 1.6 | .8925 | 1.0 | .9032 | 2.6 | .0968 | 51° 20′ |
| 38° 50′ | .7973 | 1.6 | .8915 | 1.0 | .9058 | 2.6 | .0942 | 51° 10′ |
| **39° 0** | 9.7989 | 1.5 | 9.8905 | 1.0 | 9.9084 | 2.6 | 0.0916 | **51° 0′** |
| 39° 10′ | .8004 | 1.6 | .8895 | 1.1 | .9110 | 2.5 | .0890 | 50° 50′ |
| 39° 20′ | .8020 | 1.5 | .8884 | 1.0 | .9135 | 2.6 | .0865 | 50° 40′ |
| 39° 30′ | .8035 | 1.5 | .8874 | 1.0 | .9161 | 2.6 | .0839 | 50° 30′ |
| 39° 40′ | .8050 | 1.6 | .8864 | 1.1 | .9187 | 2.5 | .0813 | 50° 20′ |
| 39° 50′ | .8066 | 1.5 | .8853 | 1.0 | .9212 | 2.6 | .0788 | 50° 10′ |
| **40° 0′** | 9.8081 | 1.5 | 9.8843 | 1.1 | 9.9238 | 2.6 | 0.0762 | **50° 0′** |
| 40° 10′ | .8096 | 1.5 | .8832 | 1.1 | .9264 | 2.5 | .0736 | 49° 50′ |
| 40° 20′ | .8111 | 1.4 | .8821 | 1.1 | .9289 | 2.6 | .0711 | 49° 40′ |
| 40° 30′ | .8125 | 1.5 | .8810 | 1.0 | .9315 | 2.6 | .0685 | 49° 30′ |
| 40° 40′ | .8140 | 1.5 | .8800 | 1.1 | .9341 | 2.5 | .0659 | 49° 20′ |
| 40° 50′ | .8155 | 1.4 | .8789 | 1.1 | .9366 | 2.6 | .0634 | 49° 10′ |
| **41° 0′** | 9.8169 | 1.5 | 9.8778 | 1.1 | 9.9392 | 2.5 | 0.0608 | **49° 0′** |
| 41° 10′ | .8184 | 1.4 | .8767 | 1.1 | .9417 | 2.6 | .0583 | 48° 50′ |
| 41° 20′ | .8198 | 1.5 | .8756 | 1.1 | .9443 | 2.5 | .0557 | 48° 40′ |
| 41° 30′ | .8213 | 1.4 | .8745 | 1.2 | .9468 | 2.6 | .0532 | 48° 30′ |
| 41° 40′ | .8227 | 1.4 | .8733 | 1.1 | .9494 | 2.5 | .0506 | 48° 20′ |
| 41° 50′ | .8241 | 1.4 | .8722 | 1.1 | .9519 | 2.5 | .0481 | 48° 10′ |
| **42° 0′** | 9.8255 | 1.4 | 9.8711 | 1.2 | 9.9544 | 2.6 | 0.0456 | **48° 0′** |
| 42° 10′ | .8269 | 1.4 | .8699 | 1.1 | .9570 | 2.5 | .0430 | 47° 50′ |
| 42° 20′ | .8283 | 1.4 | .8688 | 1.2 | .9595 | 2.6 | .0405 | 47° 40′ |
| 42° 30′ | .8297 | 1.4 | .8676 | 1.1 | .9621 | 2.5 | .0379 | 47° 30′ |
| 42° 40′ | .8311 | 1.3 | .8665 | 1.2 | .9646 | 2.5 | .0354 | 47° 20′ |
| 42° 50′ | .8324 | 1.4 | .8653 | 1.2 | .9671 | 2.6 | .0329 | 47° 10′ |
| **43° 0′** | 9.8338 | 1.3 | 9.8641 | 1.2 | 9.9697 | 2.5 | 0.0303 | **47° 0′** |
| 43° 10′ | .8351 | 1.4 | .8629 | 1.1 | .9722 | 2.5 | .0278 | 46° 50′ |
| 43° 20′ | .8365 | 1.3 | .8618 | 1.2 | .9747 | 2.5 | .0253 | 46° 40′ |
| 43° 30′ | .8378 | 1.3 | .8606 | 1.2 | .9772 | 2.6 | .0228 | 46° 30′ |
| 43° 40′ | .8391 | 1.4 | .8594 | 1.2 | .9798 | 2.5 | .0202 | 46° 20′ |
| 43° 50′ | .8405 | 1.3 | .8582 | 1.3 | .9823 | 2.5 | .0177 | 46° 10′ |
| **44° 0′** | 9.8418 | 1.3 | 9.8569 | 1.2 | 9.9848 | 2.6 | 0.0152 | **46° 0′** |
| 44° 10′ | .8431 | 1.3 | .8557 | 1.2 | .9874 | 2.5 | .0126 | 45° 50′ |
| 44° 20′ | .8444 | 1.3 | .8545 | 1.3 | .9899 | 2.5 | .0101 | 45° 40′ |
| 44° 30′ | .8457 | 1.2 | .8532 | 1.2 | .9924 | 2.5 | .0076 | 45° 30′ |
| 44° 40′ | .8469 | 1.3 | .8520 | 1.3 | .9949 | 2.6 | .0051 | 45° 20′ |
| 44° 50′ | .8482 | 1.3 | .8507 | 1.2 | .9975 | 2.5 | .0025 | 45° 10′ |
| **45° 0′** | 9.8495 | | 9.8495 | | 0.0000 | | 0.0000 | **45° 0′** |
| | Cos. | D. 1′. | Sin. | D. 1′. | Cot. | D. 1′. | Tan. | Angle. |

| A. | Sin. | Cos. | | A. | Sin. | Cos. | | A. | Sin. | Cos. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0° | .000000 | 1.0000 | 90° | 30′ | .1305 | .9914 | 30′ | 15° | .2588 | .9659 | 75° |
| 10′ | .002909 | 1.0000 | 50′ | 40′ | .1334 | .9911 | 20′ | 10′ | .2616 | .9652 | 50′ |
| 20′ | .005818 | 1.0000 | 40′ | 50′ | .1363 | .9907 | 10′ | 20′ | .2644 | .9644 | 40′ |
| 30′ | .008727 | 1.0000 | 30′ | 8° | .1392 | .9903 | 82° | 30′ | .2672 | .9636 | 30′ |
| 40′ | .011635 | .9999 | 20′ | 10′ | .1421 | .9899 | 50′ | 40′ | .2700 | .9628 | 20′ |
| 50′ | .014544 | .9999 | 10′ | 20′ | .1449 | .9894 | 40′ | 50′ | .2728 | .9621 | 10′ |
| 1° | .017452 | .9998 | 89° | 30′ | .1478 | .9890 | 30′ | 16° | .2756 | .9613 | 74° |
| 10′ | .02036 | .9998 | 50′ | 40′ | .1507 | .9886 | 20′ | 10′ | .2784 | .9605 | 50′ |
| 20′ | .02327 | .9997 | 40′ | 50′ | .1536 | .9881 | 10′ | 20′ | .2812 | .9596 | 40′ |
| 30′ | .02618 | .9997 | 30′ | 9° | .1564 | .9877 | 81° | 30′ | .2840 | .9588 | 30′ |
| 40′ | .02908 | .9996 | 20′ | 10′ | .1593 | .9872 | 50′ | 40′ | .2868 | .9580 | 20′ |
| 50′ | .03199 | .9995 | 10′ | 20′ | .1622 | .9868 | 40′ | 50′ | .2896 | .9572 | 10′ |
| 2° | .03490 | .9994 | 88° | 30′ | .1650 | .9863 | 30′ | 17° | .2924 | .9563 | 73° |
| 10′ | .03781 | .9993 | 50′ | 40′ | .1679 | .9858 | 20′ | 10′ | .2952 | .9555 | 50′ |
| 20′ | .04071 | .9992 | 40′ | 50′ | .1708 | .9853 | 10′ | 20′ | .2979 | .9546 | 40′ |
| 30′ | .04362 | .9990 | 30′ | 10° | .1736 | .9848 | 80° | 30′ | .3007 | .9537 | 30′ |
| 40′ | .04653 | .9989 | 20′ | 10′ | .1765 | .9843 | 50′ | 40′ | .3035 | .9528 | 20′ |
| 50′ | .04943 | .9988 | 10′ | 20′ | .1794 | .9838 | 40′ | 50′ | .3062 | .9520 | 10′ |
| 3° | .05234 | .9986 | 87° | 30′ | .1822 | .9833 | 30′ | 18° | .3090 | .9511 | 72° |
| 10′ | .05524 | .9985 | 50′ | 40′ | .1851 | .9827 | 20′ | 10′ | .3118 | .9502 | 50′ |
| 20′ | .05814 | .9983 | 40′ | 50′ | .1880 | .9822 | 10′ | 20′ | .3145 | .9492 | 40′ |
| 30′ | .06105 | .9981 | 30′ | 11° | .1908 | .9816 | 79° | 30′ | .3173 | .9483 | 30′ |
| 40′ | .06395 | .9980 | 20′ | 10′ | .1937 | .9811 | 50′ | 40′ | .3201 | .9474 | 20′ |
| 50′ | .06685 | .9978 | 10′ | 20′ | .1965 | .9805 | 40′ | 50′ | .3228 | .9465 | 10′ |
| 4° | .06976 | .9976 | 86° | 30′ | .1994 | .9799 | 30′ | 19° | .3256 | .9455 | 71° |
| 10′ | .07266 | .9974 | 50′ | 40′ | .2022 | .9793 | 20′ | 10′ | .3283 | .9446 | 50′ |
| 20′ | .07556 | .9971 | 40′ | 50′ | .2051 | .9787 | 10′ | 20′ | .3311 | .9436 | 40′ |
| 30′ | .07846 | .9969 | 30′ | 12° | .2079 | .9781 | 78° | 30′ | .3338 | .9426 | 30′ |
| 40′ | .08136 | .9967 | 20′ | 10′ | .2108 | .9775 | 50′ | 40′ | .3365 | .9417 | 20′ |
| 50′ | .08426 | .9964 | 10′ | 20′ | .2136 | .9769 | 40′ | 50′ | .3393 | .9407 | 10′ |
| 5° | .08716 | .9962 | 85° | 30′ | .2164 | .9763 | 30′ | 20° | .3420 | .9397 | 70° |
| 10′ | .09005 | .9959 | 50′ | 40′ | .2193 | .9757 | 20′ | 10′ | .3448 | .9387 | 50′ |
| 20′ | .09295 | .9957 | 40′ | 50′ | .2221 | .9750 | 10′ | 20′ | .3475 | .9377 | 40′ |
| 30′ | .09585 | .9954 | 30′ | 13° | .2250 | .9744 | 77° | 30′ | .3502 | .9367 | 30′ |
| 40′ | .09874 | .9951 | 20′ | 10′ | .2278 | .9737 | 50′ | 40′ | .3529 | .9356 | 20′ |
| 50′ | .10164 | .9948 | 10′ | 20′ | .2306 | .9730 | 40′ | 50′ | .3557 | .9346 | 10′ |
| 6° | .10453 | .9945 | 84° | 30′ | .2334 | .9724 | 30′ | 21° | .3584 | .9336 | 69° |
| 10′ | .10742 | .9942 | 50′ | 40′ | .2363 | .9717 | 20′ | 10′ | .3611 | .9325 | 50′ |
| 20′ | .11031 | .9939 | 40′ | 50′ | .2391 | .9710 | 10′ | 20′ | .3638 | .9315 | 40′ |
| 30′ | .11320 | .9936 | 30′ | 14° | .2419 | .9703 | 76° | 30′ | .3665 | .9304 | 30′ |
| 40′ | .11609 | .9932 | 20′ | 10′ | .2447 | .9696 | 50′ | 40′ | .3692 | .9293 | 20′ |
| 50′ | .11898 | .9929 | 10′ | 20′ | .2476 | .9689 | 40′ | 50′ | .3719 | .9283 | 10′ |
| 7° | .12187 | .9925 | 83° | 30′ | .2504 | .9681 | 30′ | 22° | .3746 | .9272 | 68° |
| 10′ | .12476 | .9922 | 50′ | 40′ | .2532 | .9674 | 20′ | 10′ | .3773 | .9261 | 50′ |
| 20′ | .12764 | .9918 | 40′ | 50′ | .2560 | .9667 | 10′ | 20′ | .3800 | .9250 | 40′ |
| 30′ | .13053 | .9914 | 30′ | 15° | .2588 | .9659 | 75° | 30′ | .3827 | .9239 | 30′ |
| | Cos. | Sin. | A. | | Cos. | Sin. | A. | | Cos. | Sin. | A. |

| A. | Sin. | Cos. | | A. | Sin. | Cos. | | A. | Sin. | Cos. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30′ | .3827 | .9239 | 30′ | **30°** | .5000 | .8660 | **60°** | 30′ | .6088 | .7934 | 30′ |
| 40′ | .3854 | .9228 | 20′ | 10′ | .5025 | .8646 | 50′ | 40′ | .6111 | .7916 | 20′ |
| 50′ | .3881 | .9216 | 10′ | 20′ | .5050 | .8631 | 40′ | 50′ | .6134 | .7898 | 10′ |
| **23°** | .3907 | .9205 | **67°** | 30′ | .5075 | .8616 | 30′ | **38°** | .6157 | .7880 | **52°** |
| 10′ | .3934 | .9194 | 50′ | 40′ | .5100 | .8601 | 20′ | 10′ | .6180 | .7862 | 50′ |
| 20′ | .3961 | .9182 | 40′ | 50′ | .5125 | .8587 | 10′ | 20′ | .6202 | .7844 | 40′ |
| 30′ | .3987 | .9171 | 30′ | **31°** | .5150 | .8572 | **59°** | 30′ | .6225 | .7826 | 30′ |
| 40′ | .4014 | .9159 | 20′ | 10′ | .5175 | .8557 | 50′ | 40′ | .6248 | .7808 | 20′ |
| 50′ | .4041 | .9147 | 10′ | 20′ | .5200 | .8542 | 40′ | 50′ | .6271 | .7790 | 10′ |
| **24°** | .4067 | .9135 | **66°** | 30′ | .5225 | .8526 | 30′ | **39°** | .6293 | .7771 | **51°** |
| 10′ | .4094 | .9124 | 50′ | 40′ | .5250 | .8511 | 20′ | 10′ | .6316 | .7753 | 50′ |
| 20′ | .4120 | .9112 | 40′ | 50′ | .5275 | .8496 | 10′ | 20′ | .6338 | .7735 | 40′ |
| 30′ | .4147 | .9100 | 30′ | **32°** | .5299 | .8480 | **58°** | 30′ | .6361 | .7716 | 30′ |
| 40′ | .4173 | .9088 | 20′ | 10′ | .5324 | .8465 | 50′ | 40′ | .6383 | .7698 | 20′ |
| 50′ | .4200 | .9075 | 10′ | 20′ | .5348 | .8450 | 40′ | 50′ | .6406 | .7679 | 10′ |
| **25°** | .4226 | .9063 | **65°** | 30′ | .5373 | .8434 | 30′ | **40°** | .6428 | .7660 | **50°** |
| 10′ | .4253 | .9051 | 50′ | 40′ | .5398 | .8418 | 20′ | 10′ | .6450 | .7642 | 50′ |
| 20′ | .4279 | .9038 | 40′ | 50′ | .5422 | .8403 | 10′ | 20′ | .6472 | .7623 | 40′ |
| 30′ | .4305 | .9026 | 30′ | **33°** | .5446 | .8387 | **57°** | 30′ | .6494 | .7604 | 30′ |
| 40′ | .4331 | .9013 | 20′ | 10′ | .5471 | .8371 | 50′ | 40′ | .6517 | .7585 | 20′ |
| 50′ | .4358 | .9001 | 10′ | 20′ | .5495 | .8355 | 40′ | 50′ | .6539 | .7566 | 10′ |
| **26°** | .4384 | .8988 | **64°** | 30′ | .5519 | .8339 | 30′ | **41°** | .6561 | .7547 | **49°** |
| 10′ | .4410 | .8975 | 50′ | 40′ | .5544 | .8323 | 20′ | 10′ | .6583 | .7528 | 50′ |
| 20′ | .4436 | .8962 | 40′ | 50′ | .5568 | .8307 | 10′ | 20′ | .6604 | .7509 | 40′ |
| 30′ | .4462 | .8949 | 30′ | **34°** | .5592 | .8290 | **56°** | 30′ | .6626 | .7490 | 30′ |
| 40′ | .4488 | .8936 | 20′ | 10′ | .5616 | .8274 | 50′ | 40′ | .6648 | .7470 | 20′ |
| 50′ | .4514 | .8923 | 10′ | 20′ | .5640 | .8258 | 40′ | 50′ | .6670 | .7451 | 10′ |
| **27°** | .4540 | .8910 | **63°** | 30′ | .5664 | .8241 | 30′ | **42°** | .6691 | .7431 | **48°** |
| 10′ | .4566 | .8897 | 50′ | 40′ | .5688 | .8225 | 20′ | 10′ | .6713 | .7412 | 50′ |
| 20′ | .4592 | .8884 | 40′ | 50′ | .5712 | .8208 | 10′ | 20′ | .6734 | .7392 | 40′ |
| 30′ | .4617 | .8870 | 30′ | **35°** | .5736 | .8192 | **55°** | 30′ | .6756 | .7373 | 30′ |
| 40′ | .4643 | .8857 | 20′ | 10′ | .5760 | .8175 | 50′ | 40′ | .6777 | .7353 | 20′ |
| 50′ | .4669 | .8843 | 10′ | 20′ | .5783 | .8158 | 40′ | 50′ | .6799 | .7333 | 10′ |
| **28°** | .4695 | .8829 | **62°** | 30′ | .5807 | .8141 | 30′ | **43°** | .6820 | .7314 | **47°** |
| 10′ | .4720 | .8816 | 50′ | 40′ | .5831 | .8124 | 20′ | 10′ | .6841 | .7294 | 50′ |
| 20′ | .4746 | .8802 | 40′ | 50′ | .5854 | .8107 | 10′ | 20′ | .6862 | .7274 | 40′ |
| 30′ | .4772 | .8788 | 30′ | **36°** | .5878 | .8090 | **54°** | 30′ | .6884 | .7254 | 30′ |
| 40′ | .4797 | .8774 | 20′ | 10′ | .5901 | .8073 | 50′ | 40′ | .6905 | .7234 | 20′ |
| 50′ | .4823 | .8760 | 10′ | 20′ | .5925 | .8056 | 40′ | 50′ | .6926 | .7214 | 10′ |
| **29°** | .4848 | .8746 | **61°** | 30′ | .5948 | .8039 | 30′ | **44°** | .6947 | .7193 | **46°** |
| 10′ | .4874 | .8732 | 50′ | 40′ | .5972 | .8021 | 20′ | 10′ | .6967 | .7173 | 50′ |
| 20′ | .4899 | .8718 | 40′ | 50′ | .5995 | .8004 | 10′ | 20′ | .6988 | .7153 | 40′ |
| 30′ | .4924 | .8704 | 30′ | **37°** | .6018 | .7986 | **53°** | 30′ | .7009 | .7133 | 30′ |
| 40′ | .4950 | .8689 | 20′ | 10′ | .6041 | .7969 | 50′ | 40′ | .7030 | .7112 | 20′ |
| 50′ | .4975 | .8675 | 10′ | 20′ | .6065 | .7951 | 40′ | 50′ | .7050 | .7092 | 10′ |
| **30°** | .5000 | .8660 | **60°** | 30′ | .6088 | .7934 | 30′ | **45°** | .7071 | .7071 | **45°** |
| | Cos. | Sin. | A. | | Cos. | Sin. | A. | | Cos. | Sin. | A. |

| A. | Tan. | Cot. | | A. | Tan. | Cot. | | A. | Tan. | Cot. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0° | .000000 | ∞ | 90° | 30′ | .1317 | 7.5958 | 30′ | 15° | .2679 | 3.7321 | 75° |
| 10′ | .002909 | 343.7737 | 50′ | 40′ | .1346 | 7.4287 | 20′ | 10′ | .2711 | 3.6891 | 50′ |
| 20′ | .005818 | 171.8854 | 40′ | 50′ | .1376 | 7.2687 | 10′ | 20′ | .2742 | 3.6470 | 40′ |
| 30′ | .008727 | 114.5887 | 30′ | 8° | .1405 | 7.1154 | 82° | 30′ | .2773 | 3.6059 | 30′ |
| 40′ | .011636 | 85.9398 | 20′ | 10′ | .1435 | 6.9682 | 50′ | 40′ | .2805 | 3.5656 | 20′ |
| 50′ | .014545 | 68.7501 | 10′ | 20′ | .1465 | 6.8269 | 40′ | 50′ | .2836 | 3.5261 | 10′ |
| 1° | .017455 | 57.2900 | 89° | 30′ | .1495 | 6.6912 | 30′ | 16° | .2867 | 3.4874 | 74° |
| 10′ | .02036 | 49.1039 | 50′ | 40′ | .1524 | 6.5606 | 20′ | 10′ | .2899 | 3.4495 | 50′ |
| 20′ | .02328 | 42.9641 | 40′ | 50′ | .1554 | 6.4348 | 10′ | 20′ | .2931 | 3.4124 | 40′ |
| 30′ | .02619 | 38.1885 | 30′ | 9° | .1584 | 6.3138 | 81° | 30′ | .2962 | 3.3759 | 30′ |
| 40′ | .02910 | 34.3678 | 20′ | 10′ | .1614 | 6.1970 | 50′ | 40′ | .2994 | 3.3402 | 20′ |
| 50′ | .03201 | 31.2416 | 10′ | 20′ | .1644 | 6.0844 | 40′ | 50′ | .3026 | 3.3052 | 10′ |
| 2° | .03492 | 28.6363 | 88° | 30′ | .1673 | 5.9758 | 30′ | 17° | .3057 | 3.2709 | 73° |
| 10′ | .03783 | 26.4316 | 50′ | 40′ | .1703 | 5.8708 | 20′ | 10′ | .3089 | 3.2371 | 50′ |
| 20′ | .04075 | 24.5418 | 40′ | 50′ | .1733 | 5.7694 | 10′ | 20′ | .3121 | 3.2041 | 40′ |
| 30′ | .04366 | 22.9038 | 30′ | 10° | .1763 | 5.6713 | 80° | 30′ | .3153 | 3.1716 | 30′ |
| 40′ | .04658 | 21.4704 | 20′ | 10′ | .1793 | 5.5764 | 50′ | 40′ | .3185 | 3.1397 | 20′ |
| 50′ | .04949 | 20.2056 | 10′ | 20′ | .1823 | 5.4845 | 40′ | 50′ | .3217 | 3.1084 | 10′ |
| 3° | .05241 | 19.0811 | 87° | 30′ | .1853 | 5.3955 | 30′ | 18° | .3249 | 3.0777 | 72° |
| 10′ | .05533 | 18.0750 | 50′ | 40′ | .1883 | 5.3093 | 20′ | 10′ | .3281 | 3.0475 | 50′ |
| 20′ | .05824 | 17.1693 | 40′ | 50′ | .1914 | 5.2257 | 10′ | 20′ | .3314 | 3.0178 | 40′ |
| 30′ | .06116 | 16.3499 | 30′ | 11° | .1944 | 5.1446 | 79° | 30′ | .3346 | 2.9887 | 30′ |
| 40′ | .06408 | 15.6048 | 20′ | 10′ | .1974 | 5.0658 | 50′ | 40′ | .3378 | 2.9600 | 20′ |
| 50′ | .06700 | 14.9244 | 10′ | 20′ | .2004 | 4.9894 | 40′ | 50′ | .3411 | 2.9319 | 10′ |
| 4° | .06993 | 14.3007 | 86° | 30′ | .2035 | 4.9152 | 30′ | 19° | .3443 | 2.9042 | 71° |
| 10′ | .07285 | 13.7267 | 50′ | 40′ | .2065 | 4.8430 | 20′ | 10′ | .3476 | 2.8770 | 50′ |
| 20′ | .07578 | 13.1969 | 40′ | 50′ | .2095 | 4.7729 | 10′ | 20′ | .3508 | 2.8502 | 40′ |
| 30′ | .07870 | 12.7062 | 30′ | 12° | .2126 | 4.7046 | 78° | 30′ | .3541 | 2.8239 | 30′ |
| 40′ | .08163 | 12.2505 | 20′ | 10′ | .2156 | 4.6382 | 50′ | 40′ | .3574 | 2.7980 | 20′ |
| 50′ | .08456 | 11.8262 | 10′ | 20′ | .2186 | 4.5736 | 40′ | 50′ | .3607 | 2.7725 | 10′ |
| 5° | .08749 | 11.4301 | 85° | 30′ | .2217 | 4.5107 | 30′ | 20° | .3640 | 2.7475 | 70° |
| 10′ | .09042 | 11.0594 | 50′ | 40′ | .2247 | 4.4494 | 20′ | 10′ | .3673 | 2.7228 | 50′ |
| 20′ | .09335 | 10.7119 | 40′ | 50′ | .2278 | 4.3897 | 10′ | 20′ | .3706 | 2.6985 | 40′ |
| 30′ | .09629 | 10.3854 | 30′ | 13° | .2309 | 4.3315 | 77° | 30′ | .3739 | 2.6746 | 30′ |
| 40′ | .09923 | 10.0780 | 20′ | 10′ | .2339 | 4.2747 | 50′ | 40′ | .3772 | 2.6511 | 20′ |
| 50′ | .10216 | 9.7882 | 10′ | 20′ | .2370 | 4.2193 | 40′ | 50′ | .3805 | 2.6279 | 10′ |
| 6° | .10510 | 9.5144 | 84° | 30′ | .2401 | 4.1653 | 30′ | 21° | .3839 | 2.6051 | 69° |
| 10′ | .10805 | 9.2553 | 50′ | 40′ | .2432 | 4.1126 | 20′ | 10′ | .3872 | 2.5826 | 50′ |
| 20′ | .11099 | 9.0098 | 40′ | 50′ | .2462 | 4.0611 | 10′ | 20′ | .3906 | 2.5605 | 40′ |
| 30′ | .11394 | 8.7769 | 30′ | 14° | .2493 | 4.0108 | 76° | 30′ | .3939 | 2.5386 | 30′ |
| 40′ | .11688 | 8.5555 | 20′ | 10′ | .2524 | 3.9617 | 50′ | 40′ | .3973 | 2.5172 | 20′ |
| 50′ | .11983 | 8.3450 | 10′ | 20′ | .2555 | 3.9136 | 40′ | 50′ | .4006 | 2.4960 | 10′ |
| 7° | .12278 | 8.1443 | 83° | 30′ | .2586 | 3.8667 | 30′ | 22° | .4040 | 2.4751 | 68° |
| 10′ | .12574 | 7.9530 | 50′ | 40′ | .2617 | 3.8208 | 20′ | 10′ | .4074 | 2.4545 | 50′ |
| 20′ | .12869 | 7.7704 | 40′ | 50′ | .2648 | 3.7760 | 10′ | 20′ | .4108 | 2.4342 | 40′ |
| 30′ | .13165 | 7.5958 | 30′ | 15° | .2679 | 3.7321 | 75° | 30′ | .4142 | 2.4142 | 30′ |
| | Cot. | Tan. | A. | | Cot. | Tan. | A. | | Cot. | Tan. | A. |

| A. | Tan. | Cot. | | A. | Tan. | Cot. | | A. | Tan. | Cot. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30′ | .4142 | 2.4142 | 30′ | **30°** | .5774 | 1.7321 | **60°** | 30′ | .7673 | 1.3032 | 30′ |
| 40′ | .4176 | 2.3945 | 20′ | 10′ | .5812 | 1.7205 | 50′ | 40′ | .7720 | 1.2954 | 20′ |
| 50′ | .4210 | 2.3750 | 10′ | 20′ | .5851 | 1.7090 | 40′ | 50′ | .7766 | 1.2876 | 10′ |
| **23°** | .4245 | 2.3559 | **67°** | 30′ | .5890 | 1.6977 | 30′ | **38°** | .7813 | 1.2799 | **52°** |
| 10′ | .4279 | 2.3369 | 50′ | 40′ | .5930 | 1.6864 | 20′ | 10′ | .7860 | 1.2723 | 50′ |
| 20′ | .4314 | 2.3183 | 40′ | 50′ | .5969 | 1.6753 | 10′ | 20′ | .7907 | 1.2647 | 40′ |
| 30′ | .4348 | 2.2998 | 30′ | **31°** | .6009 | 1.6643 | **59°** | 30′ | .7954 | 1.2572 | 30′ |
| 40′ | .4383 | 2.2817 | 20′ | 10′ | .6048 | 1.6534 | 50′ | 40′ | .8002 | 1.2497 | 20′ |
| 50′ | .4417 | 2.2637 | 10′ | 20′ | .6088 | 1.6426 | 40′ | 50′ | .8050 | 1.2423 | 10′ |
| **24°** | .4452 | 2.2460 | **66°** | 30′ | .6128 | 1.6319 | 30′ | **39°** | .8098 | 1.2349 | **51°** |
| 10′ | .4487 | 2.2286 | 50′ | 40′ | .6168 | 1.6212 | 20′ | 10′ | .8146 | 1.2276 | 50′ |
| 20′ | .4522 | 2.2113 | 40′ | 50′ | .6208 | 1.6107 | 10′ | 20′ | .8195 | 1.2203 | 40′ |
| 30′ | .4557 | 2.1943 | 30′ | **32°** | .6249 | 1.6003 | **58°** | 30′ | .8243 | 1.2131 | 30′ |
| 40′ | .4592 | 2.1775 | 20′ | 10′ | .6289 | 1.5900 | 50′ | 40′ | .8292 | 1.2059 | 20′ |
| 50′ | .4628 | 2.1609 | 10′ | 20′ | .6330 | 1.5798 | 40′ | 50′ | .8342 | 1.1988 | 10′ |
| **25°** | .4663 | 2.1445 | **65°** | 30′ | .6371 | 1.5697 | 30′ | **40°** | .8391 | 1.1918 | **50°** |
| 10′ | .4699 | 2.1283 | 50′ | 40′ | .6412 | 1.5597 | 20′ | 10′ | .8441 | 1.1847 | 50′ |
| 20′ | .4734 | 2.1123 | 40′ | 50′ | .6453 | 1.5497 | 10′ | 20′ | .8491 | 1.1778 | 40′ |
| 30′ | .4770 | 2.0965 | 30′ | **33°** | .6494 | 1.5399 | **57°** | 30′ | .8541 | 1.1708 | 30′ |
| 40′ | .4806 | 2.0809 | 20′ | 10′ | .6536 | 1.5301 | 50′ | 40′ | .8591 | 1.1640 | 20′ |
| 50′ | .4841 | 2.0655 | 10′ | 20′ | .6577 | 1.5204 | 40′ | 50′ | .8642 | 1.1571 | 10′ |
| **26°** | .4877 | 2.0503 | **64°** | 30′ | .6619 | 1.5108 | 30′ | **41°** | .8693 | 1.1504 | **49°** |
| 10′ | .4913 | 2.0353 | 50′ | 40′ | .6661 | 1.5013 | 20′ | 10′ | .8744 | 1.1436 | 50′ |
| 20′ | .4950 | 2.0204 | 40′ | 50′ | .6703 | 1.4919 | 10′ | 20′ | .8796 | 1.1369 | 40′ |
| 30′ | .4986 | 2.0057 | 30′ | **34°** | .6745 | 1.4826 | **56°** | 30′ | .8847 | 1.1303 | 30′ |
| 40′ | .5022 | 1.9912 | 20′ | 10′ | .6787 | 1.4733 | 50′ | 40′ | .8899 | 1.1237 | 20′ |
| 50′ | .5059 | 1.9768 | 10′ | 20′ | .6830 | 1.4641 | 40′ | 50′ | .8952 | 1.1171 | 10′ |
| **27°** | .5095 | 1.9626 | **63°** | 30′ | .6873 | 1.4550 | 30′ | **42°** | .9004 | 1.1106 | **48°** |
| 10′ | .5132 | 1.9486 | 50′ | 40′ | .6916 | 1.4460 | 20′ | 10′ | .9057 | 1.1041 | 50′ |
| 20′ | .5169 | 1.9347 | 40′ | 50′ | .6959 | 1.4370 | 10′ | 20′ | .9110 | 1.0977 | 40′ |
| 30′ | .5206 | 1.9210 | 30′ | **35°** | .7002 | 1.4281 | **55°** | 30′ | .9163 | 1.0913 | 30′ |
| 40′ | .5243 | 1.9074 | 20′ | 10′ | .7046 | 1.4193 | 50′ | 40′ | .9217 | 1.0850 | 20′ |
| 50′ | .5280 | 1.8940 | 10′ | 20′ | .7089 | 1.4106 | 40′ | 50′ | .9271 | 1.0786 | 10′ |
| **28°** | .5317 | 1.8807 | **62°** | 30′ | .7133 | 1.4019 | 30′ | **43°** | .9325 | 1.0724 | **47°** |
| 10′ | .5354 | 1.8676 | 50′ | 40′ | .7177 | 1.3934 | 20′ | 10′ | .9380 | 1.0661 | 50′ |
| 20′ | .5392 | 1.8546 | 40′ | 50′ | .7221 | 1.3848 | 10′ | 20′ | .9435 | 1.0599 | 40′ |
| 30′ | .5430 | 1.8418 | 30′ | **36°** | .7265 | 1.3764 | **54°** | 30′ | .9490 | 1.0538 | 30′ |
| 40′ | .5467 | 1.8291 | 20′ | 10′ | .7310 | 1.3680 | 50′ | 40′ | .9545 | 1.0477 | 20′ |
| 50′ | .5505 | 1.8165 | 10′ | 20′ | .7355 | 1.3597 | 40′ | 50′ | .9601 | 1.0416 | 10′ |
| **29°** | .5543 | 1.8040 | **61°** | 30′ | .7400 | 1.3514 | 30′ | **44°** | .9657 | 1.0355 | **46°** |
| 10′ | .5581 | 1.7917 | 50′ | 40′ | .7445 | 1.3432 | 20′ | 10′ | .9713 | 1.0295 | 50′ |
| 20′ | .5619 | 1.7796 | 40′ | 50′ | .7490 | 1.3351 | 10′ | 20′ | .9770 | 1.0235 | 40′ |
| 30′ | .5658 | 1.7675 | 30′ | **37°** | .7536 | 1.3270 | **53°** | 30′ | .9827 | 1.0176 | 30′ |
| 40′ | .5696 | 1.7556 | 20′ | 10′ | .7581 | 1.3190 | 50′ | 40′ | .9884 | 1.0117 | 20′ |
| 50′ | .5735 | 1.7437 | 10′ | 20′ | .7627 | 1.3111 | 40′ | 50′ | .9942 | 1.0058 | 10′ |
| **30°** | .5774 | 1.7321 | **60°** | 30′ | .7673 | 1.3032 | 30′ | **45°** | 1.0000 | 1.0000 | **45°** |
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